BRIEF COMMUNICATIONS

TREATMENT OF SEVERE CARDIAC CONTUSION WITH A LEFT VENTRICULAR ASSIST DEVICE IN A PATIENT WITH MULTIPLE TRAUMA

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Myocardial contusion has potentially lethal complications.[1] In cases of refractory cardiogenic shock the use of an intraaortic balloon pump (IABP) is a therapeutic option,[2,3] but a left ventricular assist device (LVAD) is not generally used because of the risk of posttraumatic bleeding.

Clinical summary. A 22-year-old woman was injured in an automobile crash, with resulting blunt trauma. On admission she had minor cranial trauma (Glasgow Coma Scale score of 13 and no intracranial hematoma on computed tomographic scan), facial trauma, and a chest injury with pulmonary contusion and myocardial contusion (electrocardiogram showing lateral ST-segment and T-wave changes; troponin Ic levels [reference range is 0-1.5 μg/L] of 4.6 μg/L on admission, 24.1 μg/L the first day, and 32 μg/L the second day; creatine kinase levels [reference range is 0-110 IU/L] of 4070 IU/L on admission, 2967 IU/L the first day, and 5607 IU/L the second day; and creatine kinase isoenzyme MB levels [reference range is 0-4 IU/L] of 191.2 IU/L on admission, 153.8 IU/L the first day, and 100.8 IU/L the second day) but without rib or sternal fracture. She also had various fractures (left humeral fracture, tibiofibular fractures in both legs, and major pelvic ring injury) and a major abdominal injury necessitating an urgent operation (resection of 10 cm ileum and suture of traumatic vesicovaginal fistula).

When taken to the operating room she had a brief cardiac arrest, followed by a second one in the recovery room (from both of which she was immediately resuscitated). Cardiogenic shock was documented with a thermodilution catheter (Swan-Ganz catheter; Baxter Healthcare Corp, Edwards Division, Santa Ana, Calif). With inotropic support (1.3 $\mu g \cdot kg^{-1} \cdot min^{-1}$ epinephrine and 16 $\mu g \cdot kg^{-1} \cdot min^{-1}$ dobutamine) the patient had a cardiac index of 1.9 L/min, an arterial pressure of 134/92 mm Hg, a pulmonary artery pressure of 31/22 mm Hg, a central venous pressure of 16 mm Hg, a pulmonary capillary wedge pressure of 22 mm Hg, and a venous oxygen saturation of 55%. A transesophageal echocardiogram showed a left ventricular ejection fraction (LVEF) of 0.25, with diffuse hypokinesia and left ventricular enlargement confirming myocardial contusion. A percutaneous IABP was therefore inserted. After brief improvement, acute ischemia of the right lower limb concurrent with degradation of her hemodynamic status led to the removal of the IABP the next day. A decision was made to institute LVAD use 72 hours after the accident because, despite maximal inotropic support, the patient had anuria and her cardiac index was 1.9 L/min, her arterial pressure was 74/43 mm Hg, her central venous pressure was 15 mm Hg, her pulmonary capillary wedge pressure was 22 mm Hg, her venous oxygen saturation was 50%, and her LVEF was 0.20 (Fig 1).

A Bio-Medicus centrifugal pump (Bio-Pump; Medtronic Bio-Medicus, Inc, Minneapolis, Minn) was implanted through a median sternotomy with right superior pulmonary venous cannulation by a 30F wire-reinforced right-angle cannula (JOSTRA Medizintechnik AG, Hirrlingen, Germany) and aortic cannulation with a Sarns 20F cannula (3M Health Care, Ann Arbor, Mich), connected to an extracorporeal bypass circuit with a Carmeda BioActive Surface (Carmeda AB, Stockholm, Sweden). The device output of 3 L/min (total cardiac output of 4.1 L/min) allowed gradual hemodynamic stabilization and progressive reduction of inotropic support. No heparin was used at that time. Revascularization of the lower limb was performed at the same time and completed with a fasciotomy. On arrival at the intensive care unit the patient had an arterial pressure of 107/75 mm Hg, a pulmonary arterial pressure of 19/10 mm Hg, a pulmonary capillary wedge pressure of 7 mm Hg, a central venous pressure of 9 mm Hg, and normal arterial blood gas values. No bleeding occurred, allowing continuous infusion of low-dose heparin (12,000 IU/24 h).

Postoperative echocardiography showed progressive recovery of left ventricular motion and normal right ventricular size (Fig 2). The patient was weaned from LVAD output at the end of postoperative day 5, and the LVAD was removed on postoperative day 6. At that time the LVEF had increased to 0.50 with low doses of dobutamine (8 $\mu g^{-1} \cdot kg^{-1} \cdot min$). Unfortunately, the right lower limb had to be amputated on postoperative day 8. The patient was operated on for orthopedic lesions on postoperative days 12 and 19 and was discharged 68 days after the initial operation. On postoperative

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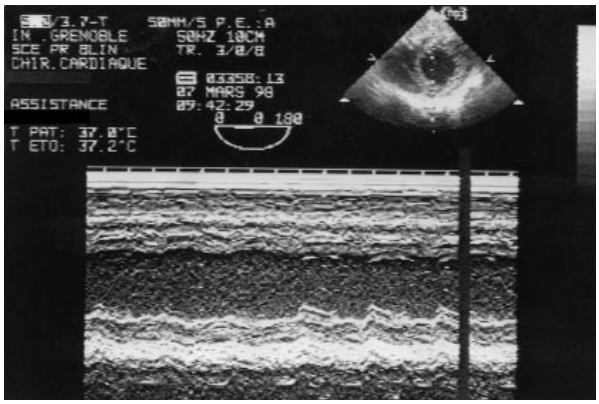

Fig 1. Transesophageal echocardiogram (short-axis view and M-mode echocardiogram) before implantation of LVAD shows severe diffuse hypokinesia of left ventricle and dilation of right ventricle with good contractility.

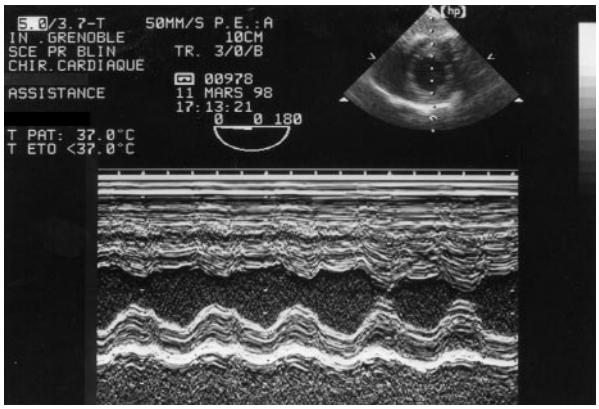

Fig. 2. Transesophageal echocardiogram (short-axis view and M-mode echocardiogram) 4 days after implantation of LVAD shows recovery of global left ventricular function and recovery of right ventricular size and thickening.

day 19 the LVEF reached 0.70. Follow-up is satisfactory at 7 months.

Comment. Use of an IABP in cases of severe myocardial contusion is a therapeutic option but it has limited effectiveness.[2,3] Furthermore, an IABP may induce vascular complications,[4] which are more frequent in female patients because of their smaller vessels,[5] as was the case in our patient (body surface area of 1.5 m^2). Despite the high mortality rate associated with severe myocardial contusion, no alternatives to medical treatment and IABP use have been described. To our knowledge no similar use of an LVAD for myocardial contusion in a patient with multiple trauma has been previously reported. Although no cerebral lesion was diagnosed in our patient, we used an LVAD as a last resort because of the bleeding and septic risks associated with the severe abdominal and pelvic injury. The indications for an LVAD were the need to remove the IABP to restore blood flow to the limb and the continued degradation of the patient's hemodynamic status. Although amputation of the right lower limb was unfortunately necessary, the LVAD allowed recovery of the severely contused myocardium within 6 days, which is a satisfactory clinical result after life-threatening cardiogenic shock. As long as there is no significant head trauma, initial LVAD insertion should be considered in such cases with severe myocardial contusion, refractory cardiogenic shock, and a high risk of vascular complications. High-flow centrifugal pump support and use of heparin-bonded bypass circuits allow minimization of heparin administration and consequently of the risk of bleeding.

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